The First Aspect of Applicants' Invention –
Electric Arc Spraying Into an Existing Carrier Substrate

One aspect of the invention is the application, by electric-arc spraying, of a metal anchor layer onto surfaces of an open carrier substrate, e.g., onto the pores, passageways, or interstices of a carrier, and applying a catalytic material to the resulting anchor layer to thereby provide a catalyst member. This method stands in contrast to prior art expedients such as that shown in Ishida et al U.S. Patent 4,455,281, wherein metal spraying of individual components of a carrier is carried out to provide on the individual components an anchor layer for a catalytic material. Only after the individual components have been metal-sprayed are they assembled into a carrier in a manner to define one or more fluid flow paths between the assembled individual components. In contrast to such prior art, the first aspect of the Applicants' invention proceeds from the surprising discovery that electric-arc spraying can be used to apply a metal anchor layer sufficiently far into the fine passageways, pores or interstices of an open carrier substrate to anchor a useful amount of catalytic material within the surface area provided by those fine passageways, pores or interstices. Such passageways, pores or interstices form at least part of the flow path for fluid (e.g., gas) flowed through the carrier. Even if such surface area, or part thereof, is obscured from the line of sight of the sprayhead from which the molten metal emanates, or is located deep within the passageways, pores or interstices, it has surprisingly been found that such surface areas can be adequately metal-coated by electric-arc spraying. In contrast, and as discussed below, while the prior art relied upon by the Examiner recognizes the problem of applying a metal coating to obscured or inaccessible portions of the surface area, it resorts to other, much less efficient expedients to solve it. For example, Ishida U.S. Patent 4,455,281 (as noted above) sprays molten metal onto individual flat plates which are then assembled into a three-dimensional body, and Fukui et al U.S. Patent 5,569,455 must resort to chemical vapor deposition ("CVD") in order to form a bonding layer in difficult-to-reach portions of the surface area.

The Second Aspect of Applicants' Invention - Reshaping of a Pliable Substrate

A second major aspect of the invention is defined, for example, in claims 40 and the claims dependent thereon, in which the anchor layer is disposed onto a pliable substrate which, either before or after the application of a catalytic material onto the anchor layer, may be reshaped, e.g., by simply bending the pliable carrier or force-fitting it into a container, to con-

form the pliable substrate to the shape of a container, pipe or the like, within which it is to be disposed.

General Statement in Support of Patentability

With respect to the first aspect of the present invention, the prior art does not show or suggest first providing a carrier substrate having gas flow passages extending through it, and then utilizing electric-arc spraying to apply a metal anchor layer to the gas flow passages of the existing substrate. Neither does the prior art show or suggest such electric arc spraying applications of the metal layer to the surfaces of such carrier members which are obscured from (not in the line of sight of) the sprayhead from which the molten or sputtered metal emanates.

With respect to the second aspect of the present invention, there is no showing whatsoever in the art of record of applying a metal anchor layer to a pliable substrate and reshaping the pliable substrate to conform it to the container after applying the metal anchor layer to it. As discussed below, the term "reshape" has a defined meaning which excludes cutting, grinding, etc.

Amendment of the Claims

Claims 22 and 27 have been amended to define the method as including first providing of at least one open carrier substrate comprising a body containing gas flow passages that define a flow path through the substrate, and then depositing the metal anchor layer onto the substrate by electric-arc spraying. Support in the application as originally filed for these amendments is found at page 10, 6th - 12th and 15th - 55th lines, and elsewhere in the application, e.g., Figures 3G, 3H, 3I and 3J, and original claim 34.

Claims 22 and 27, as amended, also require that the deposited catalytic material be located so that a fluid stream flowed through the catalyst member makes contact with the deposited catalytic material. See page 32, 11th through 13th lines of Applicants' specification as filed, for support.

Dependent claim 23 has been amended to specify that the electric-arc spraying applies metal anchor layer to obscured portions of the surface area of the substrate. Support for this amendment is found in the application as originally filed, at page 10, lines 25-32.

New claims 48-55 have been added; support for claims 48 and 49 is found in the application as originally filed, at page 33, 2nd through 6th lines; support for claim 50 is found at page 5, 1st through 3rd lines and 12th through 14th lines, and in originally filed claim 24. Support for

claims 51-54 is found at page 24, 3rd through 27th lines, and Figures 3K, 3M and 3N of the application as originally filed.

New claims 55 and 56 correspond to, respectively, originally filed claims 41 and 42, with different dependencies.

II. New Matter Objection

The Examiner has raised an objection under 35 U.S.C. 132 to the amendment to page 16 of the application filed on May 13, 2002 via the RCE. This objection is based on the Examiner's correct observation that original (and omitted) Figures 2A, 2B and 2C showed a *foam* metal substrate, whereas original Figures 2E, 2F and 2G (now renumbered as Figures 2A, 2B and 2C) show a *flat* metal substrate. The within amendment to page 16 now refers to photomicrographs "of foamed and flat metal substrates" and specifically identifies Figures 2A, 2B and 2C as showing "sections of a high temperature, *flat* steel plate substrate" (emphasis added).

Reference to "foamed and flat metal substrates" is fully supported by the specification as originally filed. For example, see page 7, the brief descriptions of Figures 1A-1D and figures 2E-2G (original numeration of the Figures). See also page 7, first full paragraph (9th through 15th lines) which describes "metal plate" and "foamed metal" among various types of substrates, and numerous other places in the specification and drawings as originally filed, including original Figures 1A-1D and 3A-3E and the descriptions thereof.

Any implication that current Figures 2A, 2B and 2C show the roughened surface of a foamed metal substrate is obviated by the reference to "a high temperature, flat steel plate substrate". That description is also fully supported by the originally-filed description of Figures 2E-2G (now 2A-2C) at page 7, third paragraph under the heading 'BRIEF DESCRIPTION OF THE DRAWINGS".

The objection under 35 USC 132 is believed to be overcome by the within amendment to page 16 of the specification.

The first full paragraph on page 24 has been amended to correct a transcription error in that jacket tube "125" in the 9th line should be "130" to conform it with the 4th line and with Figure 3K. Reference to Figure 3I has been added to the 10th line in order to identify the Figure in which item 126 appears.

Rejections Under 35 USC 102 And 35 USC 103

Most of the grounds of rejection under 35 USC 102 and 35 USC 103 are substantially identical to those set forth in the office action mailed August 14, 2001. Accordingly, rather than recapitulate the grounds of rejection and restate Applicants' earlier responses thereto, Applicants attach hereto as Attachment A a copy of the Detailed Action portion of the July 2, 2002 office action, to which Applicants have added boldface section headings corresponding to those of the following discussion. The differences between the August 14, 2001 and July 2, 2002 office actions are specifically addressed below.

III. Rejection Of Claims 22-25 and 46 Over Ishida et al '281 Under 35 U.S.C. 102

Claims 22-25 and 46 have been rejected under 35 U.S.C. 102(b) as being anticipated by Ishida et al U.S. Patent 4,455,281 ("Ishida et al '281" or "Ishida et al").

This ground of rejection is respectfully traversed, for the reasons set forth in Section III of Attachment B annexed hereto. Section III of Attachment B is a slightly modified version of Applicants' arguments advanced against this ground of rejection in Section III, pages 4-7 of the Applicants' response entered on May 13, 2002. (Throughout Attachment B, additions to the Applicant's response entered on May 13, 2002 are rendered in boldface; some minor deletions are not indicated.) In addition, Applicants comment as follows.

Ishida et al shows spraying of a metal layer onto flat plates (Figure 2), which plates may be corrugated (Figures 3 and 4) or have openings formed therein (Figures 5-14). These plates are individually sprayed to apply the metal layer, which occludes the openings. See, for example, Figures 15, 16 and, e.g., column 6, lines 35-61 and column 5, lines 42-49.

As amended, independent claims 22 and 27 require the steps of first providing the carrier body containing the gas flow passages that define the fluid flow path, and then carrying out the electric-arc spraying. Amended independent claim 46 requires the step of first providing a monolithic honeycomb carrier substrate having gas flow passages defined by walls, and then applying a metal anchor layer to the walls of the gas flow passages by electric-arc spraying.

Ishida et al discloses precisely the opposite technique. A metal layer is applied to flat plates which are then assembled parallel to each other and parallel to the gas flow, as illustrated in Figures 1 and 2, and in Figures 22 and 23. As shown by Figures 14, 15 and 16-21 of Ishida et al, the optional openings in the flat plates are completely filled by the metal, as this is desirable in order to bond together the metal layers on opposite sides of each individual plate. In this regard, see column 5, lines 42-49 and column 6, lines 35-45 of Ishida et al, which state that

the catalyst layers on either side of the metal plates are connected to each other through the openings. As shown in Figures 14 and 15-21, the optional openings in the individual plates are filled with the sprayed metal. Ishida et al therefore does not show or suggest applying a metal anchor layer to the gas flow passages of a carrier member, but only to individual components which do not define flow paths until they are assembled, post-spraying, to define flow paths only between adjacent parallel plates.

Accordingly, Ishida et al fails to show the method steps defined by the claims as amended herein, and therefore cannot sustain a rejection under 35 USC 102.

The Applicants have discovered that, surprisingly, sufficient penetration into the existing gas flow passages of a carrier substrate, even into obscured or hard-to-reach passages, is attained by electric arc spraying. The problem of (lack of) penetration into interstices, etc., by metal spraying is, as discussed in Section IV below, art-recognized, e.g., in Fukui et al U.S. Patent 5,569,455, in which chemical vapor deposition must be resorted to in order to apply a metal coating "even inside thin, deep holes or other convolutions" of a catalyst carrier.

IV. Rejection of Claims 22-33 and 40-47 Under 35 U.S.C. 103 Over Ishida et al '281 in View of Fukui et al '455

Claims 22-33 and 40-47 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Ishida et al '281 in view of Fukui et al U.S. Patent 5,569,455 ("Fukui et al '455" or "Fukui et al"). (In this portion of the office action the Examiner repeatedly refers to "Fukui '281." This discussion proceeds on the basis that Fukui et al '455 was intended.)

This ground of rejection is respectfully traversed, for the reasons set forth in Section IV of Attachment B annexed hereto. Section IV of Attachment B is a slightly modified version of Applicants' arguments advanced against this ground of rejection in Section IV, pages 7-8 of the Applicants' response entered on May 13, 2002. In addition, Applicants comment as follows.

The citation of Fukui et al is respectfully submitted to militate against the Examiner's case for obviousness of the claims. Fukui et al shows that the prior art has been constrained to resort to chemical vapor deposition to provide a bonding layer for catalysts within the fine passageways of a carrier. See column 3, lines 18-28 and column 4, lines 34-38. As reported at column 6, lines 10-19, the low-pressure chemical vapor deposition ("CVD") may be used to deposit a ceramic or an intermetallic compound as the bonding layer 14 (Figures 1(a) and 1(b)) on which a catalyst layer 16 (column 6, lines 20-21) is deposited.

As set forth at column 12, lines 11-13 of Fukui et al, a catalyst bonding layer is formed on the surface of the base material by chemical vapor deposition in an exhaust gas catalytic purifier construction. The bonding layer is described at column 12, lines 14-20 and, at column 12, lines 21-29, Fukui et al states that "the bonding layer can be formed irrespective of the shape of the base material", and that the CVD technique provides a rough bonding layer "even on a base material the shape of which would otherwise make it difficult to form a bonding layer, or which shape may be so complex that a uniform bonding layer would be impracticable to form by conventional techniques." In addition, see column 6, line 54 to column 7, line 14 of Fukui et al '455, wherein the advantages of employing chemical vapor deposition to deposit the rough bonding are listed. Among these stated advantages is

> "... (5) since reactive gas during the CVD process can enter blind spots as well, if the process is conducted at a relatively low pressure, then a bonding layer can be formed <u>even inside thin, deep holes or other convolutions;</u>..." (emphasis added).

Applicants have discovered that complex shapes and the "thin, deep holes or other convolutions" of, e.g., a honeycomb or other open carrier, can be provided with a suitable rough coating by electric arc spraying. That is a surprising discovery, as is evidenced by the teaching of Fukui et al '455 that CVD is necessary in such case.

V. Rejection of Claims 22-30 and 40-47 Under 35 U.S.C. 103(a)
<u>Over Gorynin et al in View of Rondeau and Ishida et al '281</u>

Claims 22-30 and 40-47 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Gorynin et al U.S. Patent 5, 204,302 ("Gorynin et al '302") in view of Rondeau U.S. Patent 4,027,367 ("Rondeau '367") and Ishida et al '281.

This ground of rejection is respectfully traversed, for the reasons set forth in Section V of Attachment B annexed hereto. Section V of Attachment B is a repetition of Applicants' arguments advanced against this ground of rejection in Section V, pages 9-13 of the Applicants' response entered on May 13, 2002. In addition, Applicants comment as follows.

Gorynin et al '302 shows the plasma flame application of metal or metal oxide powders to a flat substrate as illustrated, for example, in Figure 2 and described at column 6, line 23 *et seq*, and the first example at column 9. Gorynin et al '302 teaches (see the Abstract) that improved adhesion to the substrate is obtained by the formation of a diffusion layer between the

substrate and an adhesive sublayer, characterized by a smooth compositional gradient of the catalytically active component. Formation of this type of structure is attained by using plasma arc spraying to apply both the adhesive sublayer and the catalytically active component. Plasma-arc spraying is required to attain the high temperatures necessary to form a diffusion layer in the metal substrate. See column 3, lines 6-26, column 4, lines 37-41 and column 5, lines 33-43, the latter referring to a 3000°C (5,432°F) flame spraying of powder particles. Column 4, lines 37-41 states:

> "The diffusion layer **13** is formed during deposition, when the high temperatures generated by the exothermic reaction of the thermally reactive powder cause diffusion of substrate **11** and sublayer **12** material across the interface."

It therefore appears that flame or plasma-arc spraying and/or the use of exothermic powders are <u>essential</u> to the teaching of Gorynin et al '302. These elements of Gorynin '302 are not present in electric-arc spraying as required by rejected independent claims 22 and 27. As to claims 40-47, none of the cited art even remotely suggests the reshaping of a pliable substrate as claimed. Gorynin et al '302 states at column 3, line 6 *et seq* that the method of their invention is to prepare a catalyst using plasma-spray techniques, which catalyst is mechanically and catalytically superior to those of the art.

Because Rondeau '367 teaches certain advantages of electric-arc spraying, the Examiner states that it would have been obvious to one of ordinary skill in the art to use the electric-arc spraying method, instead of plasma spraying, to form the adhesive layer in Gorynin '302 "as suggested by Rondeau '367." It is respectfully submitted that the Examiner is ignoring the fact that to do so would vitiate the invention of Gorynin et al '302 and render it inoperative. Gorynin et al '302 teaches the use of plasma or flame spraying to create the required diffusion layer. It is submitted that no one skilled in the art could conceive that substituting electric-arc spraying for the plasma or flame spraying of Gorynin et al '302 would do anything but render the Gorynin et al '302 invention inoperative. Far from being obvious to combine these references, the person skilled in the art would recognize that to do so would render Gorynin et al '302 inoperative. The advantages of electric-arc spraying discussed by Rondeau '367 – economy, convenience of a wire metal supply, and the formation of a good cohesive coating – do not change the fact that electric-arc spraying appears to be incapable of providing the diffusion layer sought by Gorynin et al '302.

The second example bridging columns 9 and 10 discloses corrugating a flat metal-coated catalyzed strip (which would be of the type obtained in the first example) and rolling it into a cylinder to provide a catalyst body. Apparently, the very high temperatures obtained by the use of plasma flame spraying technique provided a secure enough bond of the plasma spray-applied materials that adherence to the flat metal substrate was not lost during corrugation and rolling.

Rondeau '367 relates to electric-arc spraying of self-bonding materials on articles generally, and does not disclose or suggest any means or method by which electric-arc spraying can apply a metal bond coat to flow passages or interstices, etc., of a carrier body.

The deficiencies of Ishida et al as a reference have been amply discussed elsewhere herein and it suffices to state that even if these three references are combined, they do not show or suggest the method defined in the claims as amended herein.

VI. Rejection of Claims 22-33 and 40-47 Under 35 U.S.C. 103(a)
Over a Combination Of Four References

Claims 22-33 and 40-47 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Gorynin et al '302 in view of Rondeau '367, Fukui et al '455, and Ishida et al '281. In making this ground of rejection the Examiner applies Gorynin et al '302, Rondeau '367 and, optionally, Ishida et al '281 as above. The Examiner notes a difference in that Gorynin et al '302 does not disclose a ferritic steel foam.

This ground of rejection is respectfully traversed, for the reasons set forth in Section VI of Attachment B annexed hereto. Section VI of Attachment B is a repetition of Applicants' arguments advanced against this ground of rejection in Section VI, pages 13-14 of the Applicants' response entered on May 13, 2002. In addition, Applicants comment as follows.

None of the cited references, nor any combination of them, shows or suggest the method defined by the amended claims which require first providing a carrier substrate comprising a body containing gas flow passages and then depositing by electric-arc spraying a metal anchor layer on which a catalytic material is deposited at locations that a fluid flowing through the carrier substrate must contact the deposited catalytic material.

Gorynin et al '302 discloses the use of plasma flame spraying or flame spraying to deposit a catalytic material onto a flat substrate which is then formed into a carrier member having fluid flow passages. Rondeau '367 merely discloses electric-arc spraying onto substrates generally with no discussion of carrier structures for catalyst members or the application of the

metal layer into fluid flow passages of such carriers. Fukui et al utilizes chemical vapor deposition in order to deposit a ceramic or intermetallic compound onto such fluid flow passages and therefore it teaches away from the utilization of electric-arc spraying for the purpose. Ishida et al, as amply discussed elsewhere herein, merely discloses applying by electric-arc spraying, metal layers to flat plates, which may optionally be perforated, and then assembling the flat plates into a carrier body in order to define fluid flow paths between the parallel plates.

The combination of references is improper, as it would defeat the high temperature requirements of Gorynin '302 to utilize the electric-arc spraying of either Rondeau '367 or Ishida '281. Similarly, the chemical vapor deposition of Fukui et al contravenes the use of electric-arc spraying of Ishida '281 and Rondeau '367. Clearly, the Examiner is selecting features from different references in a combination which is not suggested by the references themselves, or which would occur to one skilled in the art, but in a combination which is directed solely by Applicants' disclosure. It is Hornbook law, and requires no citation of authority, to state that such combination is hindsight reasoning, which may not be used to support a rejection under 35 USC 103.

VII. Rejection Of Claims 40 And 44 Under 35 U.S.C. 103(a)
Over Gorynin et al '302 in View of Ishida et al '281

Claims 40 and 44 have been rejected under 35 U.S.C. 103(a) over Gorynin et al '302 in view of Ishida et al '281.

Gorynin et al '302 is applied as above, the Examiner noting that this reference uses plasma spraying to form an anchor layer. The Examiner acknowledges that Gorynin et al '302 does not disclose the step of reshaping the substrate to conform it to the container. Ishida et al '281 is applied as above to teach the use of the catalysts disposed in a catalytic reactor.

This ground of rejection is respectfully traversed, for the reasons set forth in Section VII of Attachment B annexed hereto. Section VII of Attachment B is a repetition of Applicants' arguments advanced against this ground of rejection in Section VII, pages 14-15 of the Applicants' response entered May 13, 2002. In addition, Applicants comment as follows.

The Applicants have discovered that electric-arc spraying, despite its relatively low temperature as compared to plasma spraying, nonetheless provides a strong metal anchor layer which adheres sufficiently well to a substrate so that if the substrate is pliable, and therefore may be bent or compressed to conform it to a desired shape or container, the metal anchor layer will nonetheless adhere to the substrate, thereby maintaining in place the catalyst material car-

ried by the substrate. Art such as Gorynin '302 teaches that the high temperatures of plasma arc-spraying provide an advantage in securing formation of a diffusion layer joining the substrate and the applied adhesive/catalytic layers, to help maintain a catalytically active layer deposited on the adhesive sublayer. Applicants have found, surprisingly, as reported at page 13, 19th through 22nd lines of Applicants' specification, that electric-arc spraying results in a superior bond between the resulting anchor and the substrate, even relative to plasma spraying. In any case, as pointed out in the paragraph bridging pages 17 and 18 of Applicants' specification, the strong bond of the metal anchor layer to the substrate achieved by electric-arc spraying permits the pliable substrates treated in accordance with the invention to be compressed, bent, or otherwise deformed to a desired shape or to fit into a container or pipe of particular shape. For example, see Figure 3K of Applicants' specification and the description thereof, starting at the third line of page 24 of Applicants' specification. The pliable substrate comprising the core body 125 is forced by a ram 140 through the tapered inner surface 139 of the die 138 so that as the core body 125 enters the jacket tube 130, it is compressed to reduce the diameter of the cord body periphery 126 (Figure 3I) by, in the exemplified case, 1 to 3 percent.

Neither of the reference relied upon shows or suggests applying the metal anchor layer by electric-arc spraying (and, optionally, the catalytic material) to a pliable substrate and then deforming the pliable substrate, as by bending or compressing it, to conform it to a desired shape or container.

The Examiner acknowledges that Gorynin '302 does not disclose the step of reshaping the substrate to conform to the container. The Examiner does not state where such step of reshaping is disclosed in the prior art relied upon, as the only other comment in that portion of the office action (labeled as Section VII in attached Attachment A) is that Ishida '281 is applied as previously "to teach the use of the catalyst in a catalytic reactor." The use of a catalyst in a catalytic reactor does not suggest reshaping a pliable catalyst substrate as defined in rejected claims 40 and 47 or in new dependent claims 51-54.

VIII. The Examiner's Discussion of Applicants' Arguments Filed May 13, 2002

At page 12 of the office action, the Examiner comments on arguments previously advanced by Applicants and finds the arguments not persuasive. The Examiner's reasons are marked in attached Attachment A (a copy of the Detailed Action portion of the July 2, 2002 office action) to correspond with the following headings: **VIII – Part A** through **VIII – Part J**.

VIII - Part A

This relates to the Examiner's objection to the specification and has been fully discussed in Section II above in connection with the within amendment to page 16, 4th through 26th lines of the specification.

VIII - Part B

The quoted material refers to Applicants' quotation of column 2, line 38 *et seq* of Ishida et al '281. The Examiner's statement that Applicants' claims only require that an anchor be deposited on a carrier and catalyst layer be deposited on the anchor layer is respectfully traversed. Applicants' claims concerning the first aspect of their invention (see Section I, above) as amended herein, require first providing an open carrier substrate having fluid flow passages and then applying by electric-arc spraying a metal anchor layer onto the substrate, with a catalytic material disposed on the anchor layer so as to be contacted by a fluid flowing through the catalyst member. In some cases (claim 23) the substrate may include an obscured surface. In other cases, the metal anchor layer and catalytic material are applied to the walls of the gas-flow passages of a monolithic honeycomb carrier substrate (e.g., claims 46 and 47).

Applicants' claims defining the second aspect of their invention (see Section I above) require (claim 40) depositing an anchor layer onto a pliable substrate and depositing a catalytic material onto the anchor layer, and reshaping the pliable substrate. The reshaping may be done to conform the pliable substrate to a mounting container to provide the defined catalyst member, as defined in new dependent claims 51-54.

The Examiner also states that the "Applicants' claims do not exclude the joining of the catalyst layer as long as they are formed by electric arc spraying," citing Ishida et al (column 2, lines 45-47) as disclosing that the layers of catalytic substance are "jointed to each other through perforations." Ishida et al discloses (column 5, lines 42-49) that "the catalyst layers disposed at the opposite sides of the [substantially flat] metal plate are anchored through the openings" of the perforated plate "so that the extent of cohesion of the catalyst can be increased. Additionally, this effect can be further facilitated by mixing a filler with the catalyst."

These disclosures of Ishida '281 do not appear to be relevant to the claims at issue. In this regard, Ishida '281 merely shows application of the metal spray to the surfaces of individual, substantially flat metal plates with bleed-through of the applied metals through the optional perforations in the plates (e.g., openings 6B in Figures 5 and 6). The Examiner's statement that the claims do not exclude "the joining of catalyst layers on opposite sides of the carrier" is not

pertinent to issues of patentability. What is pertinent is whether Ishida fairly shows or suggests the method of the amended claims. For the reasons stated in Section III and elsewhere above, Ishida does not make any such showing. It is not required that the claims exclude each and every feature of a prior art reference. It is only required that the claims define a method which is novel and unobvious relative to the teachings of the reference, and all the prior art, taken as a whole. As discussed in Section III above, Ishida fails to show or suggest electric arc spraying of a bond coat onto an existing carrier substrate body having fluid flow passages therein.

VIII - Part C

The Examiner contends that Figure 5 of Ishida et al '281 shows a "reticulate" configuration which meets the terms of claim 22. This issue has been rendered moot by the amendment of claims 22 and 27 to delete the "reticulate" language.

At page 10 of Applicants' specification, open substrates are defined as including honeycomb-type monoliths, woven or non-woven mesh, wadded fibers, foamed or an otherwise reticulated or lattice-like "three-dimensional structure". The method defined by the amended claims requires depositing by electric-arc spraying a metal feed stock onto an existing substrate carrier having gas flow passages, including, in one aspect of the invention defined by dependent claim 23, depositing the metal coating on at least a portion of the surface area of the carrier which is "obscured", i.e., which is not in line of sight of the sprayhead. Ishida et al '281 discloses only spraying individual, substantially flat metal plates, and thereafter assembling the sprayed plates into a cube-like "three-dimensional structure" as illustrated in Figure 2. There is no teaching in Ishida et al '281 to lead the skilled practitioner to the counter-intuitive method of depositing molten metal by electric-arc spraying into the flow passages of an existing carrier structure, because the skilled practitioner would conclude that interstices, obscured surface areas, etc., would not be coated by the metal spraying and/or that the openings or pores of the carrier structure, especially the fine pores,[1] would be occluded by the sprayed metal.

[1] As discussed elsewhere herein and as disclosed at page 33, 2nd through 6th lines of Applicants' specification, there may be from 60 to 700 or more gas flow passages per square inch of face area of a honeycomb carrier.

VIII – Part D

The Examiner states that Fukui et al '455 is not applied to teach the method of forming the anchor layer[2], but contends that Fukui et al '455 suggests that it is obvious to use a metal carrier.

The relevance of this statement to the claims at issue is not appreciated. What is at issue is the patentability of the claimed method of manufacturing a catalyst member, whether the carrier is ceramic, metal or other material.

VIII – Part E

The general reference in Rondeau '367 that the use of thermal spraying may be used for "many other purposes" does not provide a teaching to the art to specifically use electric-arc metal spraying to coat the fine passageways, pores of interstices of catalyst carrier substrates utilizing the method steps defined in the claims. In one sense at least, electric-arc spraying is analogous to spray-painting; normally, it is applied to readily accessible surfaces, and because the spray consists of molten or mostly molten metal, the discovery that it can nonetheless be used in the preparation of catalyst members to penetrate fine passageways or coat surfaces not in line of sight from the sprayhead, is an invention which advances the art of catalyst manufacture. Further, as discussed in detail in Part V above, the art which the Examiner contends provides the motivation to make the combination of references in fact teaches away therefrom. Specifically, Gorynin is not properly combinable with Ishida et al '281, nor with Rondeau '367. Such combination requires contravening the teaching of Gorynin et al '302 to utilize plasma-arc spray (or, flame spraying) in order to obtain the benefit of temperatures high enough to form a diffusion layer. The Examiner is relying on the discredited use of hindsight reasoning by utilizing the Applicants' disclosure not only to combine references, but to contravene the specific disclosure of the combined references.

VIII – Part F

The Applicant has not argued that Rondeau '367 requires carrying out the electric arc-spraying process at high temperature. Rondeau indeed discloses electric-arc spraying and provides examples, as noted by the Examiner, of 950 and 1200°F, per Example VI of Rondeau

[2] As discussed above, Fukui et al '455 teaches the use of low pressure chemical vapor deposition in order to coat "blind spots" in the structure being coated. This further emphasizes the unobviousness of Applicants' invention, which utilizes electric-arc spraying to coat reticulate three-dimensional bodies. This is counter-intuitive, inasmuch as even those skilled in the art would assume that electric-arc spraying of molten metal would occlude the interstices of a three-dimensional body.

'367. The point is that combining the teaching of Rondeau '367, which teaches the use of relatively low-temperature electric-arc spraying, with the teaching of Gorynin '302, which teaches and requires the use of plasma or flame spraying, is a combination of directly opposite teachings which, if made, renders the invention of Gorynin et al '302 inoperative. There is nothing in these references to suggest the combination, and in fact, the Examiner is indulging in the discredited use of hindsight reasoning to make the combination.

<u>VIII – Part G</u>

See the discussion above under VIII – Part E.

<u>VIII – Part H</u>

See the discussion above under VIII – Part C.

<u>VIII – Part I</u>

The fact that metal foam and honeycomb structures each have "cells" does not make those structures equivalent; the word "cell" refers to very different structures when used relative to metal foam than when it is used relative to honeycomb-type monoliths. The "cells" of a metal foam are generally spherical in shape, and for want of a better description, might be likened to a barrel filled with porous ping-pong balls, each individual ball defining a cell. In contrast, the "cells" of a honeycomb structure are longitudinally extending, fine passages extending generally parallel to each other from the inlet face to the outlet face of the honeycomb. Page 14, 26th through 29th lines of Applicants' specification describes the cells of foamed metal substrates as having mean cell diameters in the range of 0.5 to 5 mm. In contrast, the paragraph bridging pages 32 and 33 of Applicants' specification describes the passages of a honeycomb carrier as being straight, parallel passages extending from the inlet to the outlet of the honeycomb and of a cross-sectional area small enough that from 60 to 700 or more such passages ("cells") may be present per square inch of face area. The mere fact that the same word "cell" is sometimes used to describe these very different structures does not make the structures "the same." For example, the structure of Applicants' Figure 1B is not "the same" as that of Applicants' Figure 5.

VIII – Part J

The Examiner here contends that Fukui et al '455 is relied upon to teach the use of honeycomb structure, which the Examiner considers to be the same as foam. In this regard, see the discussion above under VIII – Part I.

1X. Claims 40 and 44, Rejected For Reasons Stated Above

See the discussion in Section VII above. As therein pointed out, there is no showing in the art which even remotely suggests the claimed method.

X. The Examiner's Discussion of Applicants' Response to the Examiner's Comments

The Examiner's comments have either been mooted by the claim amendments made herein, or dealt with in the above discussion so that further comments do not appear to be warranted.

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In view of the foregoing, reconsideration and withdrawal of the rejection and allowance of each of the pending claims as amended herein is respectfully requested.

Respectfully submitted,

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P-1572-1\response4(cmp)

SERIAL NO: 09/293,216 January 2, 2003

ATTY DKT: 4339/4358A

GROUP ART UNIT: 1754

AMENDMENT TO SPECIFICATION

(Added material is in bold face and underlined, deleted material is in brackets.)

Page 16, 4th through 26th lines:

There is a dramatic difference in the surface of an anchor layer applied in accordance with the present invention as compared to the surface of a metal substrate without the anchor layer. Figures 1A through 1D are photomicrographs of a foamed metal substrate taken at a variety of magnification levels. These Figures show that the substrate has a three-dimensional web-like structure having smooth surfaces. By comparison, photomicrographs of [a] foamed **<u>and flat</u>** metal [substrate] **<u>substrates</u>** taken at corresponding and higher magnification levels after an anchor layer has been electric-arc sprayed thereon show the roughened surface that results from electric-arc spraying an anchor layer onto a substrate as taught herein. For example, Figures 2A, 2B and 2C show sections of a high temperature**<u>, flat</u>** steel plate substrate 100 and a nickel aluminide anchor layer 110 electric-arc sprayed thereon, at magnifications of 500x, 1.51kx and 2.98kx, respectively. As is evident from these Figures, the anchor layer 110 provides a highly irregular surface on the substrate 100. Accordingly, the anchor layer 110 effectively increases the surface area on which catalytic material may be deposited on the carrier relative to a non-sprayed substrate and it provides structural features such as crevices, nooks, etc., that help prevent spalling of catalytic material from the anchor layer. Figures 2A through 2C illustrate that the relatively low temperature of the electric-arc spray process deposits the metal feedstock for the anchor layer on the substrate at a temperature that permits the feedstock to freeze when it impinges upon the substrate rather than remaining molten and flowing into a smoother configuration.

Page 24, 3rd through 10th lines:

A preferred way of inserting the core body 125 into the jacket tube 130 is depicted in Figure 3K. As shown, the jacket tube 130 is mounted on a pedestal 136 and fitted at its upper end with an annular tapered die 138 having a frusto conical inner surface 139 which converges downwardly to an inside diameter equal to the inside diameter of the jacket tube 130. A ram 140 is used to force the core body 125 through the tapered inner surface 139 of the die 138 so that as the core body enters the jacket tube [125] **130** it is compressed to reduce the diameter of the core body periphery 126 **(Figure 3I)** by the approximately one to three percent indicated above.

SERIAL NO: 09/293,216 January 2, 2003
ATTY DKT: 4339/4358A
GROUP ART UNIT: 1754

AMENDMENT TO THE CLAIMS

(Added material is in boldface and underlined, deleted material is in brackets.)

22. (Twice Amended) A method for manufacturing a catalyst member comprising:

first, providing an open carrier substrate comprising a body containing gas flow passages that define a flow path of a fluid through the substrate, and then depositing by electric arc spraying a metal feedstock onto [an open carrier] **the** substrate [of reticulate configuration,] to provide a metal anchor layer **on** [of] the substrate, and

depositing a catalytic material onto the anchor layer**, which catalytic material is located so that a fluid stream flowed through the catalyst member makes contact with the deposited catalytic material**.

23. (Twice Amended) The method of any one of claims 22, 27[,] **or** 40, [46 and 47 comprising depositing the catalytic material by means other than electric arc spraying.] **including carrying out the electric arc spraying from a sprayhead, and wherein the substrate has an obscured surface area defined by portions of the substrate which are obscured relative to a line of sight from the sprayhead, and providing the metal anchor layer on at least a portion of the obscured surface area.**

24. (Amended) The method of claim [23] **22** wherein depositing the catalytic material comprises coating the metal anchor layer with a catalytic material comprising a refractory metal oxide support on which one or more catalytic components are dispersed.

27. (Twice Amended) A method for manufacturing a catalyst member comprising:

first, providing at least one open carrier substrate comprising a body containing gas flow passages that define a flow path of a fluid through the substrate, and then electric arc spraying a metal feedstock onto [at least one open carrier] **the** substrate [of reticulate configuration,] to provide at least one substrate having an anchor layer coated thereon;

depositing onto the anchor layer a catalytic material comprised of a bulk refractory metal oxide having dispersed thereon one or more catalytically active components to provide at least one catalyzed substrate**, the catalytic material being located so that a fluid stream flowed through the catalyst member makes contact with the deposited catalytic material**; and

incorporating the at least one catalyzed substrate into a body configured to define an inlet opening and an outlet opening and so configuring and disposing the at least one catalyzed substrate between the inlet and outlet openings to define a plurality of fluid flow paths therebetween.

46. (Amended) A method for manufacturing a catalyst member comprising:

first, providing [depositing by electric arc spraying a metal feedstock onto] a monolithic honeycomb carrier substrate having a plurality of gas flow passages extending therethrough from an inlet face to an outlet face of the carrier, the passages being defined by walls**,** [and the metal feedstock being sprayed onto the walls to provide a metal anchor layer thereon] **and then depositing a metal feedstock by electric arc spraying onto the walls of the passages of the carrier substrate to provide a metal anchor layer thereon**; and

depositing a catalytic material onto the anchor layer.

47. (Amended) A method for manufacturing a catalyst member comprising:

first, providing [electric arc spraying a metal feedstock onto] a monolithic honeycomb carrier substrate having a plurality of gas flow passages extending therethrough from an inlet face to an outlet face of the carrier, the passages being defined by walls [and the metal feedstock being sprayed onto the walls to provide a metal anchor layer thereon] **, and then depositing a metal feedstock by electric arc spraying onto the walls of the passages to provide a metal anchor layer thereon**;

depositing onto the anchor layer a catalytic material comprised of a bulk refractory metal oxide having dispersed thereon one or more catalytically active components to provide at least one catalyzed substrate; and

incorporating the at least one catalyzed substrate into a body configured to define an inlet opening and an outlet opening and so configuring and disposing the at least one catalyzed substrate between the inlet and outlet openings to define a plurality of fluid flow paths therebetween.